Tenmile River Watershed Summary

Mixville Pond

WATERSHED DESCRIPTION AND MAPS

The Tenmile River watershed covers an area of approximately 16,974 acres in the southern coastal area of Connecticut (Figure 1). There are multiple municipalities located at least partially in the watershed, including the Cheshire, Prospect, and Southington, CT.

The Tenmile River watershed includes one segment (Mixville Pond) impaired for recreation due to elevated bacteria levels. This segment was assessed by Connecticut Department of Energy and Environmental Protection (CT DEEP) and included in the CT 2010 303(d) list of impaired waterbodies. Some segments in the watershed are currently unassessed as of the writing of this document. This does not suggest that there are no issues on these segments, but indicates a lack of current data to evaluate the segments as part of the assessment process. An excerpt of the Integrated Water Quality Report is included in Table 1 to show the status of waterbodies in the watershed (CTDEEP, 2010).

The bacteria impaired segment is a 10.68-acre impoundment along the Tenmile River known as Mixville Pond (CT5202-00-1-L3_01) (Figure 2). This impaired segment is located in the Town of Cheshire, east of the Prospect and Cheshire town line. The pond is located northeast of Plank Road in Prospect and west of Mixville Road in Cheshire (Figure 2).

Mixville Pond has a water quality classification of A. Designated uses include potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. This segment of the river is impaired due to elevated bacteria concentrations, affecting the designated use of recreation. Mixville Pond is a designated beach and the specific recreation impairment is for designated swimming and other water contact related activities.

Impaired Segment Facts

Impaired Segment:
Mixville Pond (CT5202-00-1-L3_01)

Municipality: Cheshire

Impaired Segment Area (Acres):
10.68

Water Quality Classification:
Class A

Designated Use Impairment:
Recreation

Sub-regional Basin Name and Code: Tenmile River, 5202

Regional Basin: Quinnipiac

Major Basin: South Central Coast

Watershed Area (acres): 16,974

MS4 Applicable? Yes

Applicable Season: Recreation Season (May 1 to September 30)

Figure 1: Watershed location in Connecticut

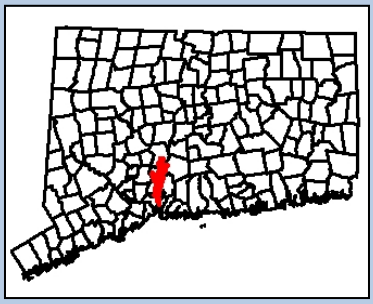


Table 1: Impaired segment and nearby waterbodies from the Connecticut 2010 Integrated Water Quality Report

Waterbody ID	Waterbody Name	Location	Miles/ Acres	Aquatic Life	Recreation	Fish Consumption
CT5202-00-1-L3_01	Mixville Pond (Cheshire)	Mixville Road, Cheshire. Impoundment at head of Tenmile River	10.68	U	NOT	FULL
CT5202-00_01	Tenmile River (Southington/Cheshire)-01	From mouth at confluence with Quinnipiac River (DS of Old Turnpike Road crossing), Southington, US to Lake Percivel outlet dam on Moss Farms Pond (just US of Jarvis Street crossing), Cheshire.	4.1	NOT	U	FULL
CT5202-00_02	Tenmile River (Cheshire)-02	From inlet to Moss Farms Pond (on southwest end), US to headwaters at Mixville Pond outlet dam (just US of Notch Road crossing), Cheshire.	1.42	FULL	U	FULL

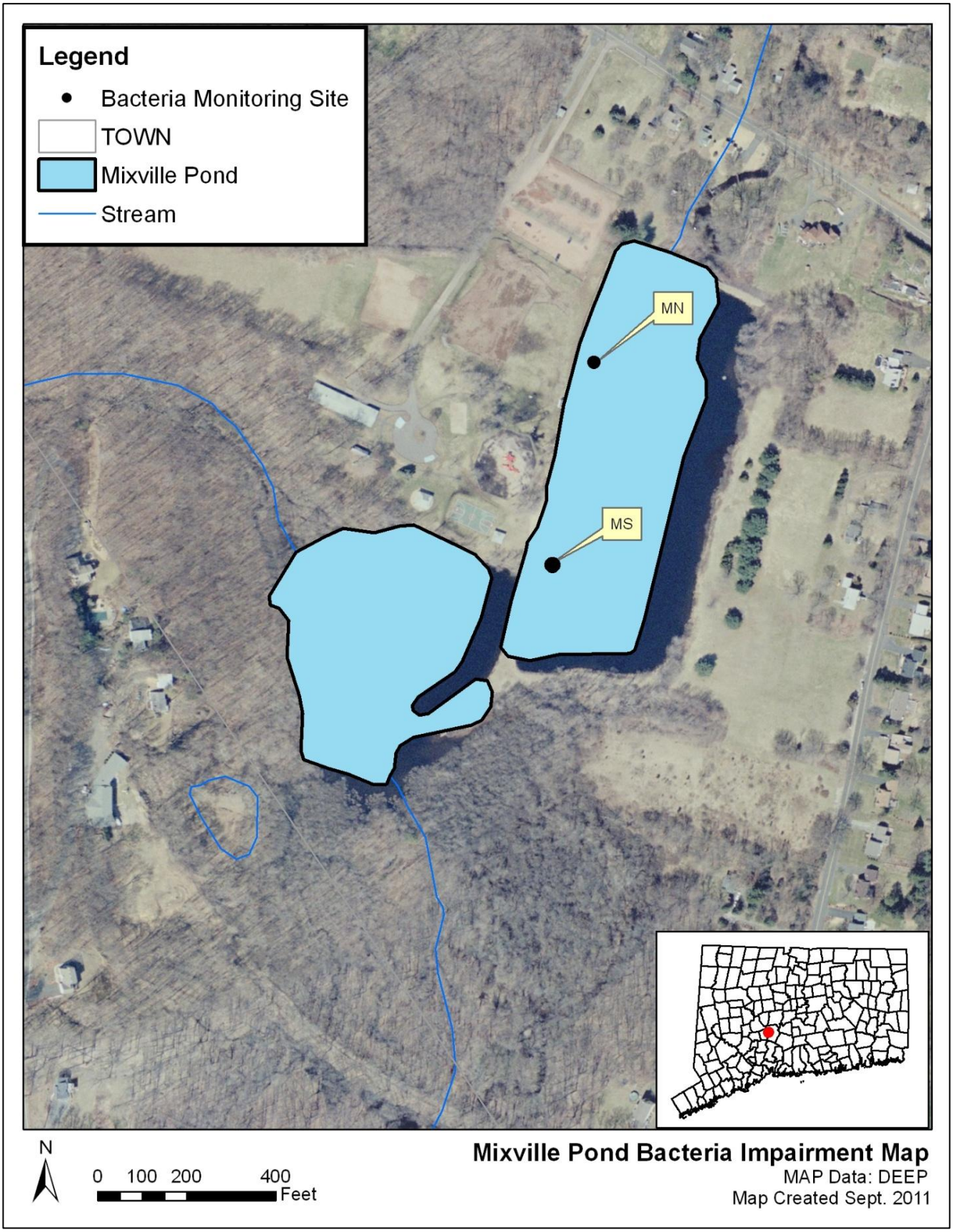
Shaded cells indicate impaired segment addressed in this TMDL

FULL = Designated Use Fully Supported

NOT = Designated Use Not Supported

U = Unassessed

Figure 2: GIS map featuring general information of Mixville Pond and the surrounding landscape.



Land Use

Existing land use can affect the water quality of waterbodies within a watershed (USEPA, 2011c). Natural processes, such as soil infiltration of stormwater and plant uptake of water and nutrients, can occur in undeveloped portions of the watershed. As impervious surfaces (such as rooftops, roads, and sidewalks) increase within the watershed landscape from commercial, residential, and industrial development, the amount of stormwater runoff to waterbodies also increases. These waterbodies are negatively affected as increased pollutants from nutrients and bacteria from failing and insufficient septic systems, oil and grease from automobiles, and sediment from construction activities become entrained in this runoff. Agricultural land use activities, such as fertilizer application and manure from livestock, can also increase pollutants in nearby waterbodies (USEPA, 2011c).

As shown in Figures 3 and 4, the Tenmile River watershed consists of 55% forest, 34% urban area, 6% agriculture, and 5% water. Portions of the watershed in Cheshire, particularly surrounding the impaired waterbody, are characterized by urban and forested land uses with dense residential development to the east of Mixville Pond. There are multiple agricultural areas adjacent to the Tenmile River upstream and downstream of the impaired waterbody. While much of the western portion of the watershed is dominated by forest, most of the northern and eastern areas of the watershed are dominated by urban land use (Figure 4).

Figure 3: Land use within the Tenmile River watershed

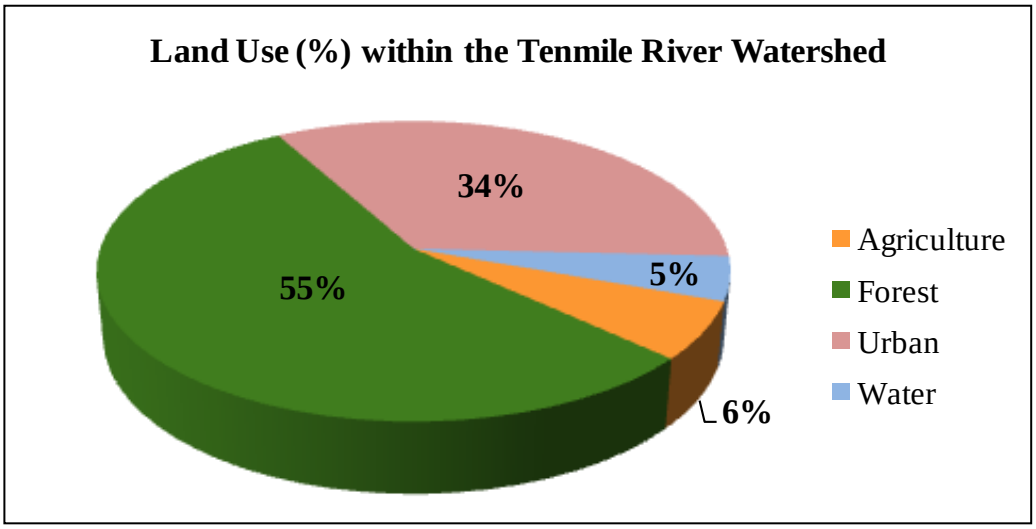
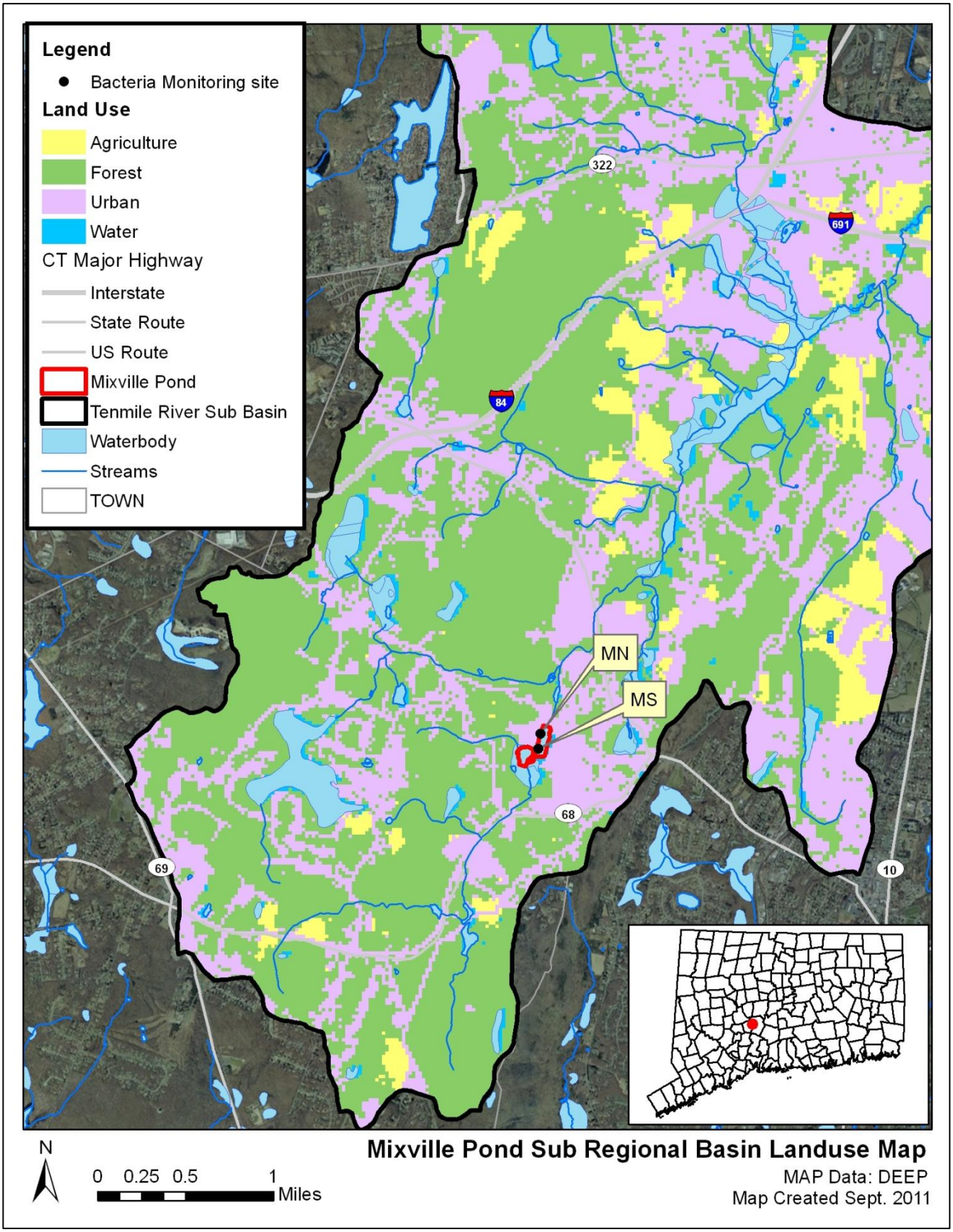


Figure 4: GIS map featuring land use for the Tenmile River watershed at the sub-regional level



WHY IS A TMDL NEEDED?

E. coli is the indicator bacteria used for comparison with the CT State criteria in the CT Water Quality Standards (WQS) (CTDEEP, 2011). All data results are from CT DEEP, USGS, Bureau of Aquaculture, or volunteer monitoring efforts at stations located on the impaired segments.

Table 2: Sampling station location description for the impaired segment in the Tenmile River Watershed (stations organized downstream to upstream)

Waterbody ID	Waterbody Name	Station	Station Description	Municipality	Latitude	Longitude
CT5202-00-1-L3_01	Mixville Pond	MN	Mixville North	Cheshire	--	--
CT5202-00-1-L3_01	Mixville Pond	MS	Mixville South	Cheshire	--	--

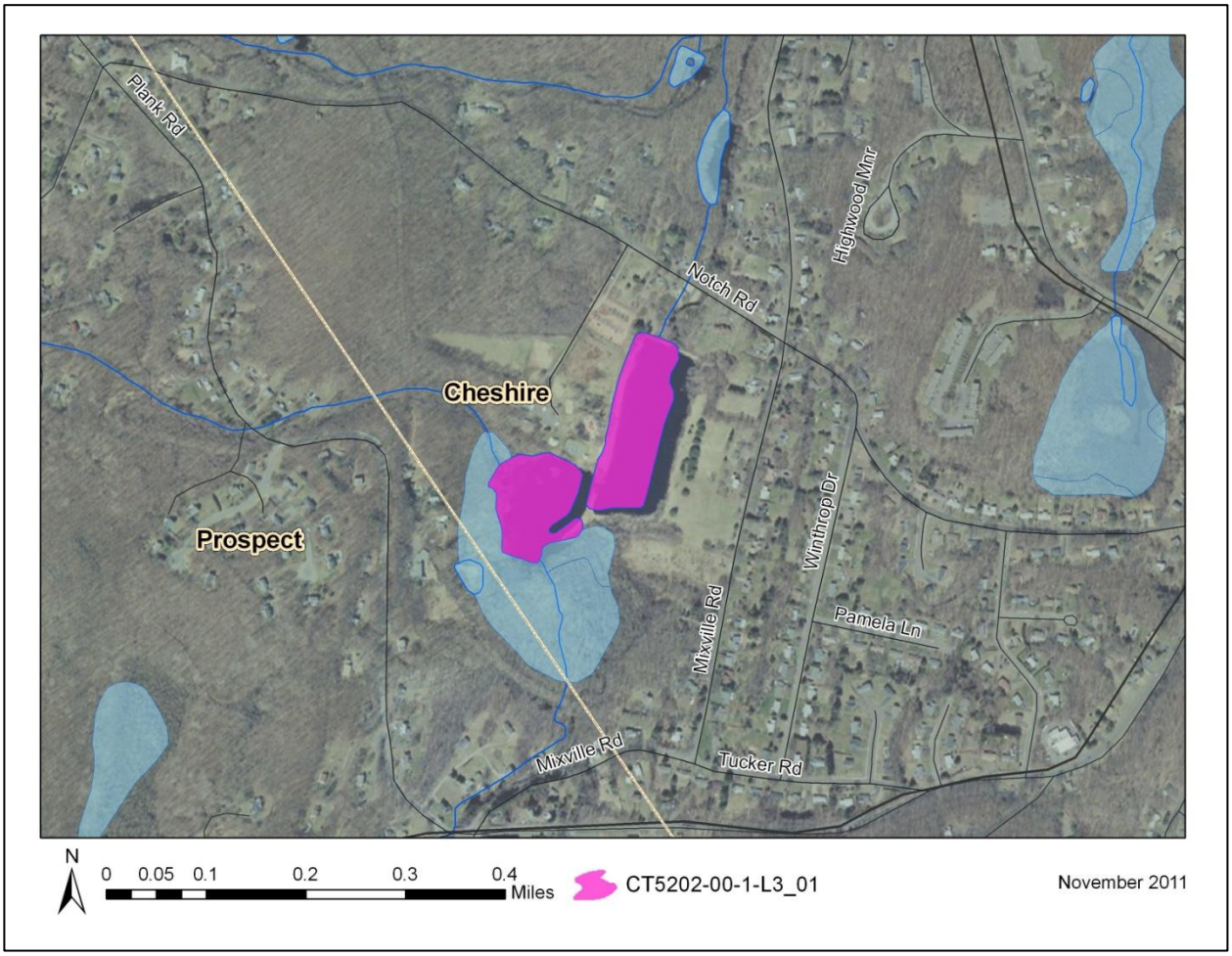
Mixville Pond (CT5202-00-1-L3_01) is a Class A freshwater pond (Figure 5). Its applicable designated uses are potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. Water quality analyses were conducted using data from two sampling locations, MS and MN, between 2008 and 2011 (Table 2).

The water quality criteria for *E. coli*, along with bacteria sampling results from 2008-2011, are presented in Table 9. The annual geometric mean was calculated for Station MS and exceeded the WQS for *E. coli* in 2009, 2010, and 2011. The annual geometric mean was calculated for Station MN and exceeded the WQS for *E. coli* in 2010 and 2011. Single sample values at both stations (MS and MN) exceeded the WQS for *E. coli* multiple times each year.

To aid in identifying possible bacteria sources, the geometric mean was also calculated for each station for wet-weather and dry-weather sampling days, where appropriate (Table 9). For Stations MN and MS in Mixville Pond, the wet-weather geometric means exceeded the WQS for *E. coli*.

Due to the elevated bacteria measurements presented in Table 9, Mixville Pond did not meet CT's bacteria WQS, was identified as impaired, and was placed on the CT List of Waterbodies Not Meeting Water Quality Standards, also known as the CT 303(d) Impaired Waters List. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. The goal is for all waterbodies to comply with State WQS.

Figure 5: Aerial map of Mixville Pond



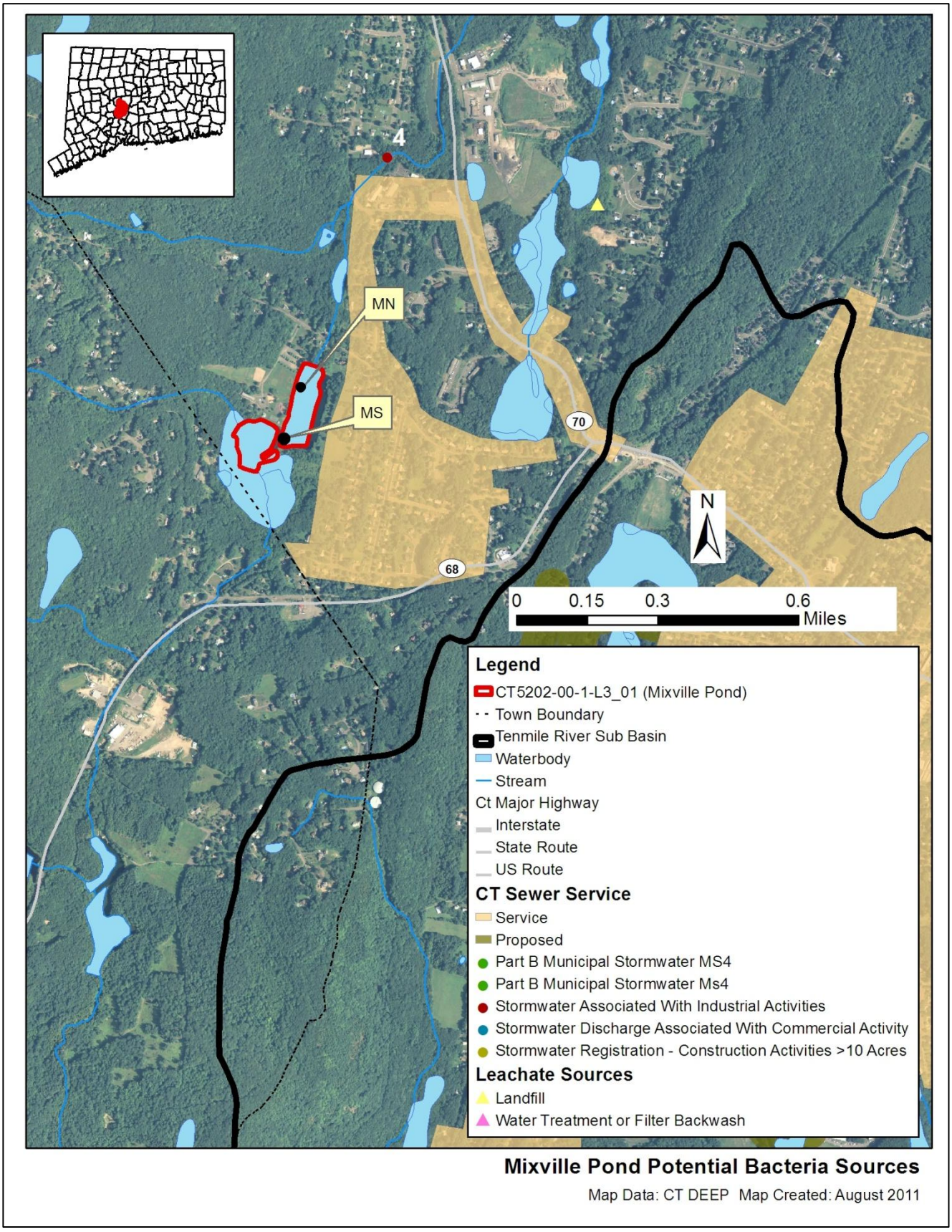
POTENTIAL BACTERIA SOURCES

Potential sources of indicator bacteria in a watershed include point and non-point sources, such as stormwater runoff, agriculture, sanitary sewer overflows (collection system failures), illicit discharges, and inappropriate discharges to the waterbody. Potential sources that have been tentatively identified in the watershed based on land use (Figures 3 and 4) and a collection of local information for the impaired waterbody is presented in Table 3 and Figure 6. However, the list of potential sources is general in nature and should not be considered comprehensive. There may be other sources not listed here that contribute to the observed water quality impairment in the study segments. Further monitoring and investigation will confirm listed sources and discover additional ones. Some segments in this watershed are currently listed as unassessed by CT DEEP procedures. This does not suggest that there are no potential issues on this segment, but indicates a lack of current data to evaluate the segment as part of the assessment process. For some segments, there are data from permitted sources, and CT DEEP recommends that any elevated concentrations found from those permitted sources be addressed through voluntary reduction measures. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement these TMDLs.

Table 3: Potential bacteria sources to Mixville Pond in the Tenmile River watershed

Impaired Segment	Permit Source	Illicit Discharge	CSO/SSO Issue	Failing Septic System	Agricultural Activity	Stormwater Runoff	Nuisance Wildlife/ Pets	Other
Mixville Pond CT5202-00-1-L3_01	x	x		x	x	x	x	x

Figure 6: Potential sources near Mixville Pond in the Tenmile River watershed



The potential sources map for the impaired basin was developed after thorough analysis of available data sets. If information is not displayed in the map, then no sources were discovered during the analysis. The following is the list of potential sources that were evaluated: problems with migratory waterfowl, golf course locations, reservoirs, proposed and existing sewer service, cattle farms, poultry farms, permitted sources of bacteria loading (surface water discharge, MS4 permit, industrial stormwater, commercial stormwater, groundwater permits, and construction related stormwater), and leachate and discharge sources (agricultural waste, CSOs, failing septic systems, landfills, large septic tank leach fields, septage lagoons, sewage treatment plants, and water treatment or filter backwash).

Point Sources

Permitted sources within the watershed that could potentially contribute to the bacteria loading are identified in Table 4. This table includes permit types that may or may not be present in the impaired watershed. A list of active permits in the watershed is included in Table 5. Additional investigation and monitoring could reveal the presence of additional discharges in the watershed. Available effluent data from each of these permitted categories found within the watershed are compared to the CT State WQS for the appropriate receiving waterbody use and type. When available, bacteria data results from these permitted sources are listed in Table 6.

Table 4: General categories list of other permitted discharges

Permit Code	Permit Description Type	Number in watershed
CT	Surface Water Discharges	0
GPL	Discharge of Swimming Pool Wastewater	0
GSC	Stormwater Discharge Associated with Commercial Activity	3
GSI	Stormwater Associated with Industrial Activity	8
GSM	Part B Municipal Stormwater MS4	2
GSN	Stormwater Registration – Construction	1
LF	Groundwater Permit (Landfill)	0
UI	Underground Injection	0

Permitted Sources

As shown in Table 5, there are multiple permitted discharges in the Tenmile River watershed. Bacteria data from 2001-2003 from several of these industrial permitted facilities are included in Table 6. Though this data cannot be compared to a water quality standard as Connecticut does not have a recreation standard for fecal coliform bacteria, multiple samples were high. Samples taken from the Cheshire DPW's Permit (GSI001174) exceeded 10,000 colonies/100mL on several occasions, and Arch Chemicals (GSI001205) and Consolidated Industries (GSI001401) exceeded 1,000 colonies/100mL on several sample dates.

Since the MS4 permits are not targeted to a specific location, but the geographic area of the regulated municipality, there is no one accurate location on the map to display the location of these permits. One dot will be displayed at the geographic center of the municipality as a reference point. Sometimes this location falls outside of the targeted watershed and therefore the MS4 permit will not be displayed in the

Potential Sources Map. Using the municipal border as a guideline will show which areas of an affected watershed are covered by an MS4 permit.

Table 5: Permitted facilities within the Tenmile River watershed

Town	Client	Permit ID	Permit Type	Site Name/Address	Map #
Cheshire	Consolidated Industries Acquisition Corp	GSI001401	Stormwater Associated With Industrial Activities	Consolidated Industries Acquisition Corp	4
Cheshire	Town Of Cheshire	GSI002413	Stormwater Associated With Industrial Activities	Dattco Cheshire	5
Cheshire	Dattco, Inc.	GSI002414	Stormwater Associated With Industrial Activities	Dattco Cheshire	6
Cheshire	United Technologies Corporation	GSI000535	Stormwater Associated With Industrial Activities	Pratt & Whitney After Market Services	9
Cheshire	Atlantic Inertial Systems Inc.	GSI001624	Stormwater Associated With Industrial Activities	Atlantic Inertial Systems Inc.	10
Cheshire	Smith-Renaud, Inc.	GSI000372	Stormwater Associated With Industrial Activities	Smith-Renaud Inc.	11
Cheshire	Ogs Technologies Inc	GSI001602	Stormwater Associated With Industrial Activities	Ogs Technologies, Inc.	12
Cheshire	Qtg-Tropicana	GSI002304	Stormwater Associated With Industrial Activities	615 W Johnson Ave	13
Cheshire	Atlantic Star Trailers	GSC000216	Stormwater Discharge Associated With Commercial Activity	Atlantic Star Trailers	7
Cheshire	Bozzuto's Inc.	GSC000050	Stormwater Discharge Associated With Commercial Activity	Bozzuto’s, Inc.	8
Cheshire	Town Of Cheshire	GSM000021	Part B Municipal Stormwater MS4	Cheshire, Town Of	N/A
Prospect	Town Of Prospect	GSM000110	Part B Municipal Stormwater Ms4	Prospect, Town Of	N/A(2)
Prospect	Ltf Builders, Llc	GSN001738	Stormwater Registration - Construction Activities >10 Acres	Woodmont Estates	3
Southington	Ta Operating Corporation	GSC000228	Stormwater Discharge Associated With Commercial Activity	Milldale Travelcenter	14

Table 6: Industrial permits in the Tenmile River watershed and available fecal coliform data (colonies/100mL). The results cannot be compared to the water quality standard as there is no recreation standard for fecal coliform.

Town	Location	Permit Number	Receiving Water	Sample Location	Sample Date	Result
Cheshire	Town of Cheshire-DPW	GSI001174	Tenmile River	Channel 008	09/20/01	>10000
Cheshire	Town of Cheshire	GSI001174	Tenmile River	Channel 008	11/12/02	6,800
Cheshire	Town of Cheshire-DPW	GSI001174	Tenmile River	outfall 15" RCP 001	09/20/01	>10000
Cheshire	Town of Cheshire	GSI001174	Tenmile River	outlet 15" RCP 001	11/12/02	6,300
Cheshire	Town of Cheshire-DPW	GSI001174	Tenmile River	stone lined swale 006	09/20/01	20,800
Cheshire	Town of Cheshire	GSI001174	Tenmile River	stone lined swale 006	11/12/02	500
Cheshire	Arch Chemicals	GSI001205	Tenmile River	N end of property	09/20/01	1,700
Cheshire	Arch Chemicals	GSI001205	Tenmile River	N end of property	09/15/02	12,000
Cheshire	Watkins Motor Lines	GSI001394	Tenmile River	001	03/05/03	100
Cheshire	Watkins Motor Lines	GSI001394	Tenmile River	001	07/23/03	900
Cheshire	Watkins Motor Lines	GSI001394	Tenmile River	001	07/17/01	120
Cheshire	Watkins Motor Lines	GSI001394	Tenmile River	004	07/17/01	20
Cheshire	Consolidated Industries	GSI001401	Tenmile River	#3	06/21/01	100
Cheshire	Consolidated Industries	GSI001401	Tenmile River	#5	06/21/01	100
Cheshire	Consolidated Industries	GSI001401	Tenmile River	#7	06/21/01	100
Cheshire	Consolidated Industries	GSI001401	Tenmile River	#9	06/21/01	5,200
Cheshire	Consolidated Industries	GSI001401	Tenmile River	Outfall 001 (C1)	12/11/02	100
Cheshire	Consolidated Industries	GSI001401	Tenmile River	Outfall 002 (C2)	12/11/02	100
Cheshire	Smith-Renaud Inc	GSI000372	Tenmile River	SD E side	07/26/01	320

Municipal Stormwater Permitted Sources

Per the EPA Phase II Stormwater rule all municipal storm sewer systems (MS4s) operators located within US Census Bureau Urbanized Areas (UAs) must be covered under MS4 permits regulated by the appropriate State agency. There is an EPA waiver process that municipalities can apply for to not participate in the MS4 program. In Connecticut, EPA has granted such waivers to 19 municipalities. All participating municipalities within UAs in Connecticut are currently regulated under MS4 permits by CT DEEP staff in the MS4 program.

The US Census Bureau defines a UA as a densely settled area that has a census population of at least 50,000. A UA generally consists of a geographic core of block groups or blocks that exceeds the 50,000 people threshold and has a population density of at least 1,000 people per square mile. The UA will also include adjacent block groups and blocks with at least 500 people per square mile. A UA consists of all or part of one or more incorporated places and/or census designated places, and may include additional territory outside of any place. (67 FR 11663)

For the 2000 Census a new geographic entity was created to supplement the UA blocks of land. This created a block known as an Urban Cluster (UC) and is slightly different than the UA. The definition of a UC is a densely settled area that has a census population of 2,500 to 49,999. A UC generally consists of a geographic core of block groups or blocks that have a population density of at least 1,000 people per square mile, and adjacent block groups and blocks with at least 500 people per square mile. A UC consists of all or part of one or more incorporated places and/or census designated places; such a place(s) together with adjacent territory; or territory outside of any place. The major difference is the total population cap of 49,999 people for a UC compared to >50,000 people for a UA. (67 FR 11663)

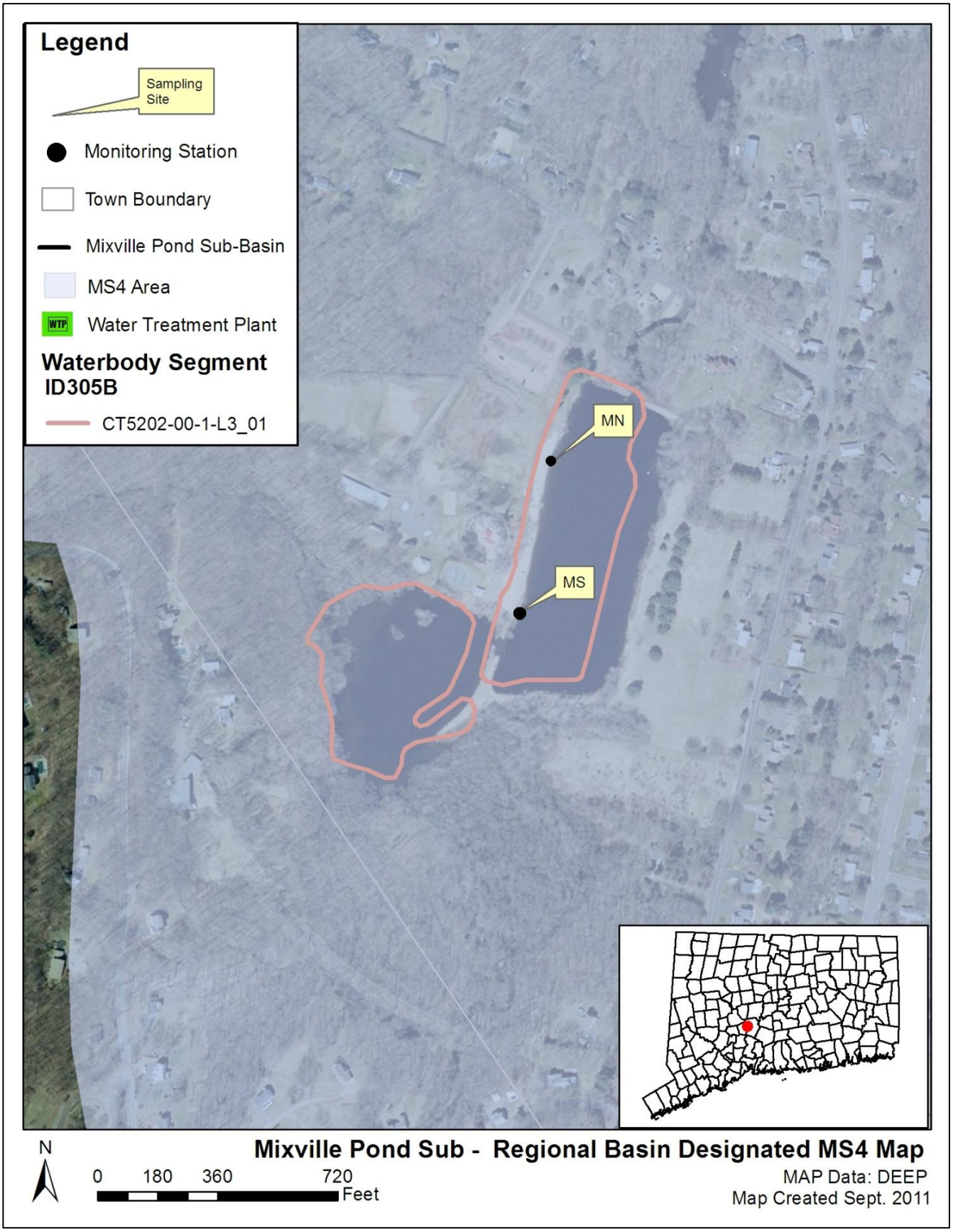
While it is possible that CT DEEP will be expanding the reach of the MS4 program to include UC municipalities in the near future they are not currently under the permit. However, the GIS layers used to create the MS4 maps in this Statewide TMDL did include both UA and UC blocks. This factor creates some municipalities that appear to be within an MS4 program that are not currently regulated through an MS4 permit. This oversight can explain a municipality that is at least partially shaded grey in the maps and there are no active MS4 reporting materials or information included in the appropriate appendix. While these areas are not technically in the MS4 permit program, they are still considered urban by the cluster definition above and are likely to contribute similar stormwater discharges to affected waterbodies covered in this TMDL.

As previously noted, EPA can grant a waiver to a municipality to preclude their inclusion in the MS4 permit program. One reason a waiver could be granted is a municipality with a total population less than 1000 people, even if the municipality was located in a UA. There are 19 municipalities in Connecticut that have received waivers, this list is: Andover, Bozrah, Canterbury, Coventry, East Hampton, Franklin, Haddam, Killingworth, Litchfield, Lyme, New Hartford, Plainfield, Preston, Salem, Sherman, Sprague, Stafford, Washington, and Woodstock. There will be no MS4 reporting documents from these towns even if they are displayed in an MS4 area in the maps of this document.

The list of US Census UCs is defined by geographic regions and is named for those regions, not necessarily by following municipal borders. In Connecticut the list of UCs includes blocks in the following Census Bureau regions: Colchester, Danielson, Lake Pocotopaug, Plainfield, Stafford, Storrs, Torrington, Willimantic, Winsted, and the border area with Westerly, RI (67 FR 11663). Any MS4 maps showing these municipalities may show grey areas that are not currently regulated by the CT DEEP MS4 permit program.

Mixville Pond, the impaired segment in the Tenmile River watershed, is located within the Town of Cheshire near the Prospect and Cheshire town line. Both Cheshire and Prospect have designated urban areas, as defined by the U.S. Census Bureau, and are required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems (MS4 permit) issued by the Connecticut Department of Energy and Environmental Protection (DEEP) (Figure 7). This general permit is only applicable to municipalities that are identified in Appendix A of the MS4 permit that contain designated urban areas and discharge stormwater via a separate storm sewer system to surface waters of the State. The permit required municipalities to develop a Stormwater Management Plan (SMP) to reduce the discharge of pollutants as well as to protect water quality. The MS4 permit is discussed further in the "TMDL Implementation Guidance" section of the core TMDL document. Additional information regarding stormwater management and the MS4 permit can be obtained on CTDEEP's website (http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325702&depNav_GID=1654).

Figure 7: MS4 areas surrounding Mixville Pond



Non-point Sources

Non-point source pollution (NPS) comes from many diffuse sources and is more difficult to identify and control. NPS pollution is often associated with land-use practices. Examples of NPS that can contribute bacteria to surface waters include insufficient septic systems, pet and wildlife waste, agriculture, and contact recreation (swimming or wading). Potential sources of NPS within the Tenmile River watershed are described below.

Wildlife and Domestic Animal Waste

Wildlife and domestic animals within the Tenmile River watershed represent a potential source of bacteria. With the construction of roads and drainage systems, these wastes may no longer be retained on the landscape, but instead may be conveyed via stormwater to the nearest surface water. These physical land alterations can exacerbate the impact of natural sources on water quality (USEPA, 2001).

Mixville Park is located on the western shore of Mixville Pond. The open space in this park and the pond itself may provide an area for waterfowl to congregate. Geese and other waterfowl are known to congregate in open areas including recreational fields, agricultural cropfields, and golf courses. In addition to creating a nuisance, large numbers of geese can also create unsanitary conditions on the grassed areas and cause water quality problems due to bacterial contamination associated with their droppings. Large populations of geese can also lead to habitat destruction as a result of overgrazing on wetland and riparian plants. These factors make wildlife waste a potential source of bacteria to the Tenmile River watershed.

Dense residential development is located east of the impaired waterbody (Figure 5). When not properly disposed, waste from domestic animals, such as dogs, can enter surface waters directly or through stormwater infrastructure. Therefore, domestic animal waste may also be contributing to bacteria concentrations in Mixville Pond.

Insufficient Septic Systems and Illicit Discharges

As shown in Figure 6, only residential development to the east of the impaired segment relies on the municipal sewer system. The majority of the watershed relies on onsite wastewater treatment systems, such as septic systems. Insufficient or failing septic systems can be significant sources of bacteria by allowing raw waste to reach surface waters. In Connecticut, local health directors or health districts are responsible for keeping track of any reported insufficient or failing septic systems in a specific municipality. The Towns of Cheshire and Prospect do not have a specific health director, but are part of the Chesprocott Health District in Cheshire (http://www.chesprocott.org/).

The area surrounding the eastern portion of the Mixville Pond is serviced by the municipal sewer system (Figure 6). Sewer system leaks and other illicit discharges can contribute bacteria to nearby surface waters.

Recreation at Mixville Park Beach

Humans coming in direct contact with surface water presents another potential source of bacterial contamination. Microbial source tracking (MST) surveys conducted at beaches in New Hampshire have shown humans at beaches to be a source of bacterial contamination (Jones, 2008). There is a designated beach on Mixville Pond located near Station MN at Mixville Park. It is possible that humans are depositing fecal matter, which contains high levels of bacteria, directly into Mixville Pond at the town

beach. The beach is a popular destination for local residents during the summer months when sampling is conducted.

Stormwater Runoff from Developed Areas

The majority of the Tenmile River watershed is undeveloped. However, approximately 34% of the land use in the watershed is considered urban, and a portion of that area is concentrated around the impaired waterbody (Figures 4 and 9). Urban areas are often characterized by impervious cover, or surface areas such as roofs and roads that force water to run off land surfaces rather than infiltrate into the soil. Studies have shown a link between increasing impervious cover and degrading water quality conditions in a watershed (CWP, 2003). In one study, researchers correlated the amount of fecal coliform to the percent of impervious cover in a watershed (Mallin *et al.*, 2000).

A large portion of the Tenmile River watershed is characterized by land with 7-11% impervious cover, with only 18% of the watershed characterized by areas of less than 6% impervious cover. Since 26% of the watershed area is comprised of land with 12-15% impervious cover, 83% of the watershed consists of land areas with greater than 7% impervious cover (Figure 8). The amount of impervious surfaces in the watershed and the proximity of those surfaces to Mixville Pond indicate that stormwater runoff is a potential source of bacterial contamination.

High geometric means during wet-weather may indicate that stormwater runoff is contributing to the bacterial impairment in a waterbody. As shown in Table 9, the geometric mean for wet weather exceeded the WQS at both stations in Mixville Pond, indicating that stormwater runoff is likely a source of bacteria to the pond.

Figure 8: Range of impervious cover (%) in the Tenmile River watershed

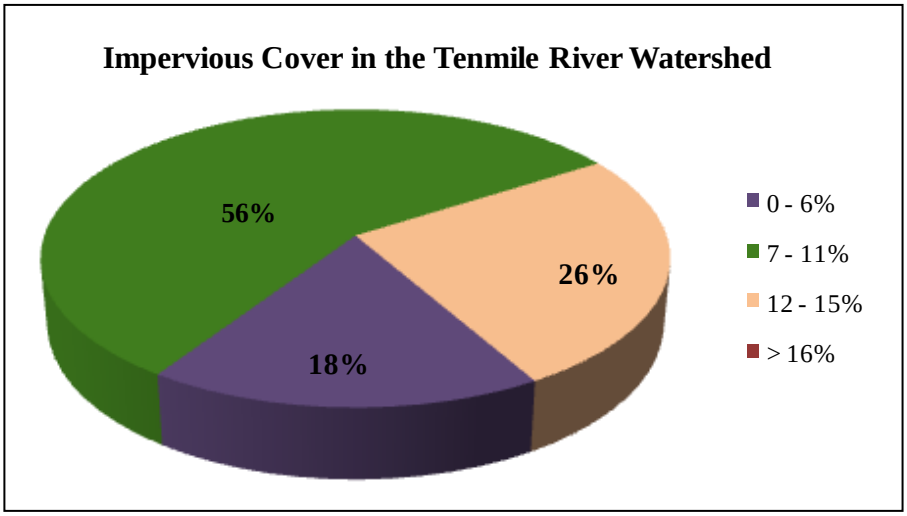
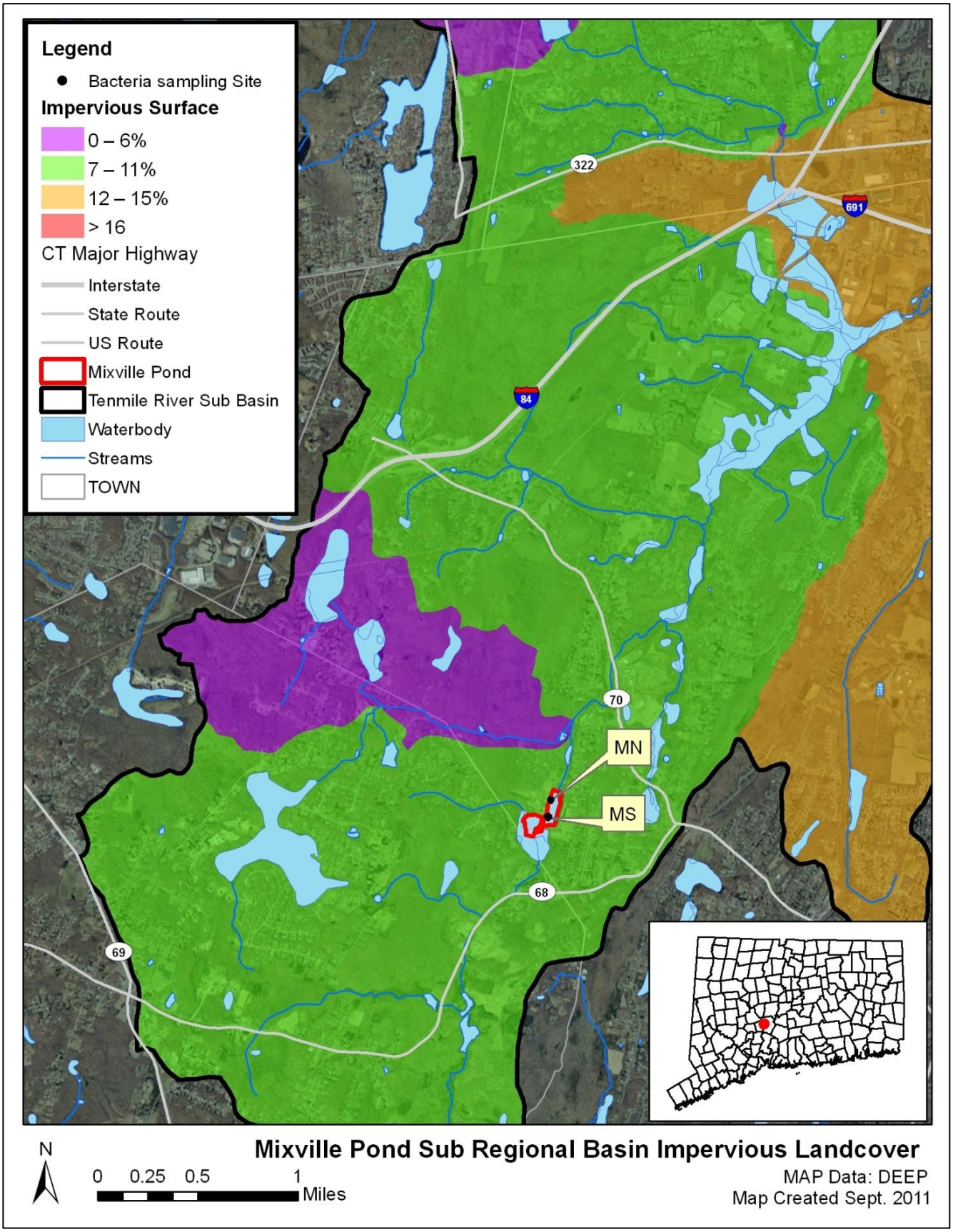


Figure 9: Impervious cover (%) for the Tenmile River sub-regional watershed



Agricultural Activities

Agricultural operations are an important economic activity and landscape feature in many areas of the State. Runoff from agricultural fields may contain pollutants such as bacteria and nutrients (USEPA, 2011a). This runoff can include pollutants from farm practices such as storing manure, allowing livestock to wade in nearby waterbodies, applying fertilizer, and reducing the width of vegetated buffer along the shoreline. Agricultural land use makes up 6% of the Tenmile River watershed. There are several agricultural areas upstream of Mixville Pond directly adjacent to tributaries. These agricultural areas upstream of the impaired segment are potentially carrying pollutants, including bacteria, into the tributaries of the impaired waterbody.

Most agricultural areas in the watershed are located downstream of Mixville Pond. The downstream sections of the Tenmile River near farmland are not currently classified as impaired for recreation, but these areas are yet to be assessed for this impairment (Table 1). Agricultural activities adjacent to the Tenmile River along the currently unimpaired segments are potentially carrying pollutants, including bacteria, into the river.

Additional Sources

Discharge sampling by the Town of Cheshire have shown high levels of fecal coliform bacteria on several sampling dates (Table 6). These sample results indicate that these discharges may also be a source of *E.coli* bacteria.

Arch Chemicals, located at 350 Knotter Drive in Cheshire, is a biocide company that develops chemistry based products to destroy harmful microbes. The discharge from Arch Chemicals has been shown to contain high levels of fecal coliform bacteria (Table 6), indicating this discharge may also be a source of bacterial contamination.

Consolidated Industries, located at 677 Mixville Road in Cheshire, produces forgings from ferrous, non-ferrous, and exotic metals for the Aerospace, and High-Tech markets. The discharge from Consolidated Industries has been shown to contain high levels of fecal coliform bacteria (Table 6), indicating this discharge may also be a source of bacterial contamination.

There may be other sources not listed here or identified in Figure 6 that contribute to the observed water quality impairment in Mixville Pond. Further monitoring and investigation will confirm the listed sources and discover additional ones. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement this TMDL.

Land Use/Landscape

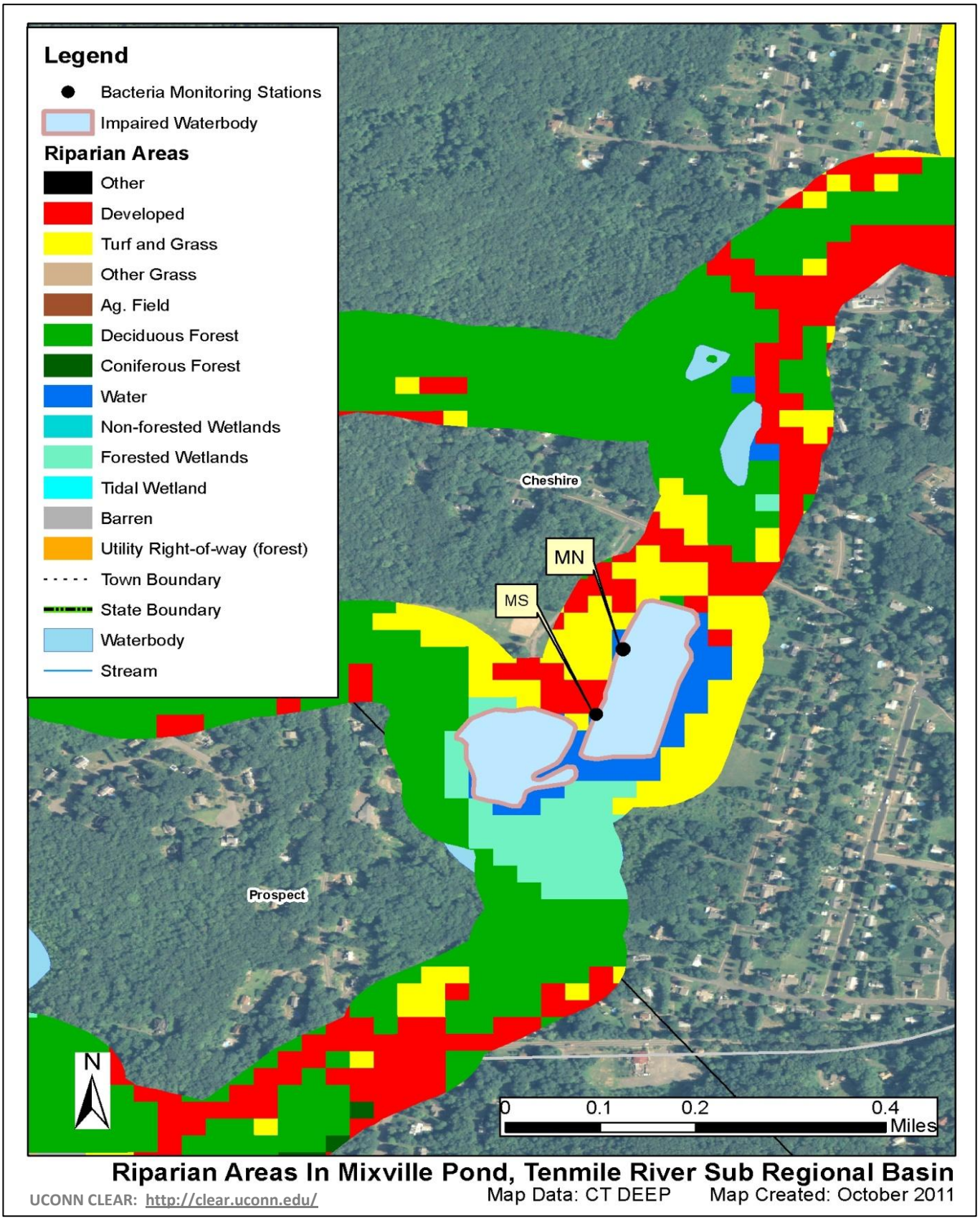
Riparian Buffer Zones

The riparian buffer zone is the area of land located immediately adjacent to streams, lakes, or other surface waters. The boundary of the riparian zone and the adjoining uplands is gradual and not always well-defined. However, riparian zones differ from uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. Through the interaction of their soils, hydrology, and vegetation, natural riparian areas influence water quality as contaminants are taken up into plant tissues, adsorbed onto soil particles, or modified by soil organisms. Any change to the natural riparian buffer zone can reduce the effectiveness of the natural buffer and has the potential to contribute to water quality impairment (USEPA, 2011b).

The CLEAR program at UCONN has created streamside buffer layers for the entire State of Connecticut (http://clear.uconn.edu/), which have been used in this TMDL. Analyzing this information can reveal potential sources and implementation opportunities at a localized level. The land use directly adjacent to a waterbody can have direct impacts on water quality from surface runoff sources.

The majority of the riparian zone for the impaired segment of Mixville Pond in the Tenmile River watershed is characterized by developed, turf grass, and non-forested wetland land uses (Figure 10). Riparian areas upstream of this impaired segment are characterized by deciduous forest and developed land uses. As previously mentioned, developed areas are a potential source of bacterial contamination.

Figure 10: Riparian buffer zone information for the Tenmile River watershed



CURRENT MANAGEMENT ACTIVITIES

The Tenmile River is one of the major drainages of the Quinnipiac River. The Quinnipiac River Watershed Association conducts annual volunteer stream clean ups on the Tenmile River to increase community connection and awareness of water quality problems. In 2005, a Watershed Action Plan was completed for the Quinnipiac River by the Quinnipiac Watershed Partnership. This document discusses actions that communities, including Prospect and Cheshire, can take to promote local watershed protection for the Quinnipiac River and its tributaries. A draft watershed based plan for the Quinnipiac River is due out in 2012. This document will have specific information and suggestions for protecting and improving water quality in the Quinnipiac River and its tributaries, including the Tenmile River and Mixville Pond. Once complete, this document can be accessed through the CT DEEP website (http://www.ct.gov/dep/cwp/view.asp?a=2719&q=379296&depNav_GID=1654).

The Towns of Cheshire and Prospect have developed and implemented programs to protect water quality from bacterial contamination. As indicated previously, a portion of the watershed surrounding the impaired waterbody is regulated under the MS4 program. The MS4 General Permit is required for any municipality with urbanized areas that initiates, creates, originates or maintains any discharge of stormwater from a storm sewer system to waters of the State. The MS4 permit requires towns to design a Stormwater Management Plan (SMP) to reduce the discharge of pollutants in stormwater to improve water quality. The plan must address the following 6 minimum measures:

1. Public Education and Outreach.
2. Public Involvement/Participation.
3. Illicit discharge detection and elimination.
4. Construction site stormwater runoff control.
5. Post-construction stormwater management in the new development and redevelopment.
6. Pollution prevention/good housekeeping for municipal operations.

Each municipality is also required to submit an annual update outlining the steps they are taking to meet the six minimum measures. All updates that address bacterial contamination in the watershed are summarized in Tables 7 and 8.

Table 7: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Cheshire, CT (Permit # GSM000021)

Minimum Measure	Cheshire Annual Report Update (2009)
Public Outreach and Education	1) Continues to provide information to the public via utility bills (tax and sewer users).Information regarding stormwater related issues is printed on the backside of the utility bills.
	2) Maintains stormwater outreach materials at the Chesprocott Health District office in Cheshire.
Public Involvement and Participation	1) Participated with the QRWA in the Volunteer Clean-up of the Tenmile River.

Table 7: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Cheshire, CT (Permit # GSM000021) (continued)

Minimum Measure	Cheshire Annual Report Update (2009)
Illicit Discharge Detection and Elimination	1) Implemented a manhole rehabilitation project that included the repair and rehabilitation of approximately 140 manholes in locations throughout the Town. The manholes are located along interceptor sewers located adjacent to watercourses.
	2) Continued to conducted illicit discharge inspections and remediated stormwater discharges to reduce flow at the Water Pollution Control Plant and stormwater sewer overflows.
	3) Utilized a GPS location unit to locate and inspect outfalls greater than 15 inches in diameter. Dry weather inspections were conducted and issues and/or deficiencies at drainage outlets were noted. The systems were inspected for illicit discharges and abnormal conditions. Inspections are logged and maintained in a computer database at the Town Department of Public Works.
	4) Performs stormwater sampling and testing at six residential and industrial locations in accordance with CTDEP permits.
Construction Site Stormwater Runoff Control	No updates.
Post Construction Stormwater management	No updates.
Pollution Prevention and Good Housekeeping	1) Expanded annual training program to address park facilities and other municipal buildings. Training to include handling of chemicals such as chlorine, fertilizers, and pesticides.
	2) Removed sediment, trash and debris from catch basins, including the area surrounding major rivers and brooks.

Table 8: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Prospect, CT (Permit # GSM000110)

Minimum Measure	Prospect Annual Report Update (2007)
Public Outreach and Education	1) Provided links to the Town's Stormwater Management Plan, annual report (upon completion), and other water quality related information. Other links included on the Town's website are the Quinnipiac River Watershed Association, CT DEEP, and USEPA's Stormwater page.
	2) Became member of the Quinnipiac River Watershed Association.
Public Involvement and Participation	1) Published a public notice in the local newspaper inviting the public to view the draft version of the Town's Phase II Year 1 and Year 2 Annual report in 2004 and 2005.

Table 8: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Prospect, CT (Permit # GSM000110) (continued)

Minimum Measure	Prospect Annual Report Update (2007)
Illicit Discharge Detection and Elimination	1) Installed cameras at selected storm drains to catch illegal attachments and additions.
	2) Illicit discharges are documented by the DPW as they are detected and reported.
	3) During storm sewer repair or replacement projects, unknown or suspicious connections are removed. New storm sewer hook ups are required to obtain a Town permit.
	4) Once an illicit discharge has been detected and documented, the DPW in conjunction with the local Health Department or other governmental agencies will determine the source and eliminate the discharge as necessary.
Construction Site Stormwater Runoff Control	1) On-site inspections of permitted construction activities are made by the DPW and Planning and Zoning Department staff throughout the construction process (as frequent as two to three times per week for large projects such as major subdivisions).
	2) Enforcement actions were taken when necessary. In two instances, the Town had to issue a cease and desist order against the developer or owner for issues related to stormwater management. After this action, the responsible parties corrected the problems.
Post Construction Stormwater management	1) Takes ownership of all installed stormwater structures to ensure that operation and maintenance activities are controlled and recorded.
	2) All major stormwater structures in the Town that are maintained by the DPW are inspected approximately three times per year and maintained as necessary. Maintenance records are retained by the DPW.
Pollution Prevention and Good Housekeeping	1) During 2006, 118 curb miles were swept at least once, representing 100% of Town roadways. Approximately 452 cubic yards of material were removed from Town streets during this process.
	2) DPW employees utilize a rented catch basin cleaner to clean Town catch basins on an annual basis. The Town currently maintains a cleaning rotation in which 1/4 of all municipal catch basins are cleaned annually (approximately 400 catch basins per year).
	3) Chronic problem storm sewer lines may be TV inspected as necessary to determine their current condition and provide information about any problems.
	4) During 2006, 480 cubic yards of material was removed from the catch basins cleaned. In combination with street sweeping, over 90% of the sand applied to Town roadways during the 2005-2006 winter seasons was prevented from reaching receiving waters.
	5) Sampled six outfall locations from three different land uses (industrial, commercial, and residential).
	6) Approximately 1,900 feet of storm sewer piping was replaced in 2006. In addition, some areas of replaced sewer piping were reinforced with riprap to prevent erosion.

RECOMMENDED NEXT STEPS

As shown above, the Towns of Prospect and Cheshire have developed and implemented programs to protect water quality from bacterial contamination. Future mitigative activities are necessary to ensure the long-term protection of Mixville Pond and have been prioritized below.

1) Evaluate municipal education and outreach programs regarding animal waste.

Any education and outreach program should highlight the importance of not feeding waterfowl and wildlife, managing waste from dogs and other pets, and properly disposing of human waste (such as diapers) at Mixville Park beach. The town and residents can take measures to minimize waterfowl-related impacts such as allowing tall, coarse vegetation to grow in the riparian areas of Mixville Pond that are frequented by waterfowl, particularly in Mixville Park. Currently, the park has turf grass leading directly to Mixville Pond and the Mixville Park beach. Waterfowl, especially grazers like geese, prefer easy access to water. Maintaining an uncut vegetated buffer along the shore, or along the top of the beach, will make the habitat less desirable to geese and encourage migration. In addition, any educational program should emphasize that feeding waterfowl, such as ducks, geese, and swans, may contribute to water quality impairments in the Tenmile River watershed, especially Mixville Pond, and can harm human health and the environment.

Animal wastes should be disposed of away from any waterbody or storm drain system. BMPs effective at reducing the impact of animal waste on water quality include installing signage, providing pet waste receptacles in high-uses areas, enacting ordinances requiring the clean-up of pet waste, and targeting educational and outreach programs in problem areas.

2) Develop a system to monitor septic systems.

Though a portion of the residents within the Tenmile River watershed near the impaired segment rely on the municipal sanitary sewer system, most residents rely on septic systems. If not already in place, Prospect and Cheshire should establish a program to ensure that existing septic systems are properly operated and maintained. For instance, communities can create an inventory of existing septic systems through mandatory inspections. Inspections help encourage proper maintenance and identify failed and sub-standard systems. Policies that govern the eventual replacement of the sub-standard systems within a reasonable timeframe could also be adopted. Towns can also develop programs to assist citizens with the replacement and repair of older and failing systems.

3) Implement a program to evaluate the sanitary sewer system.

A portion of the Tenmile River watershed east of Mixville Pond relies on a municipal sewer system (Figure 6). Since this portion of the watershed is adjacent to the impaired waterbody, ensuring there are no leaks or overflows from the sanitary sewer in this area should be made a priority. Cheshire has already established a manhole rehabilitation project to repair 140 manholes along interceptor sewers adjacent to waterbodies, inspected and remediated identified illicit stormwater discharges, utilized GPS to locate and map outfalls, and conducted dry-weather inspections and stormwater testing at residential and industrial locations. Prospect has already installed cameras at select storm drains for illicit detection, and established a program to detect and eliminate stormwater discharges. It is important for Cheshire and Prospect to continue to develop programs that evaluate sanitary sewers and reduce leaks and overflows, especially in areas near Mixville Pond. This program should include periodic inspections of the sewer line.

4) Identify areas along Mixville Pond to implement Best Management Practices (BMPs) to control stormwater runoff.

As noted previously, the Towns of Cheshire and Prospect within the Tenmile River watershed are MS4 communities regulated by the MS4 program. Since 34% of the watershed is considered urban and the entire area surrounding the impaired waterbody has an impervious cover of 7-11%, stormwater runoff may be contributing bacteria to the waterbody. To identify specific areas that are contributing bacteria to the impaired segment, the town should conduct wet-weather sampling at stormwater outfalls that discharge directly to the Tenmile River. To treat stormwater runoff, the towns should also identify areas along the more developed sections of the Tenmile River, particularly near Mixville Pond, to install BMPs that encourage stormwater to infiltrate the ground before entering the Tenmile River. These BMPs would disconnect impervious areas and reduce pollutant loads to the river. More detailed information and BMP recommendations can be found in the core TMDL document.

5) Continue monitoring of permitted sources.

Previous sampling of discharge from the Town of Cheshire has shown elevated levels of fecal coliform bacteria, an indicator of bacterial pollution (Table 6). Further monitoring will provide information essential to better locate, understand, and reduce pollution sources. If any current monitoring is not done with appropriate bacterial indicator based on the receiving water, then a recommended change during the next permit reissuance is to include the appropriate indicator species. If facility monitoring indicates elevated bacteria, then implementation of permit required, and voluntary measures to identify and reduce sources of bacterial contamination at the facility are an additional recommendation. Regular monitoring should be established for all permitted sources to ensure compliance with permit requirements and to determine if current requirements are adequate or if additional measures are necessary for water quality protection.

Section 6(k) of the MS4 General Permit requires a municipality to modify their Stormwater Management Plan to implement the TMDL within four months of TMDL approval by EPA if stormwater within the municipality contributes pollutant(s) in excess of the allocation established by the TMDL. For discharges to impaired waterbodies, the municipality must assess and modify the six minimum measures of its plan, if necessary, to meet TMDL standards. Particular focus should be placed on the following plan components: public education, illicit discharge detection and elimination, stormwater structures cleaning, and the repair, upgrade, or retrofit of storm sewer structures. The goal of these modifications is to establish a program that improves water quality consistent with TMDL requirements. Modifications to the Stormwater Management Plan in response to TMDL development should be submitted to the Stormwater Program of DEEP for review and approval.

Table 9 details the appropriate bacteria criteria for use as waste load allocations established by this TMDL for use as water quality targets by permittees as permits are renewed and updated, within the Tenmile River watershed.

For any municipality subject to an MS4 permit and affected by a TMDL, the permit requires a modification of the SMP to include BMPs that address the included impairment. In the case of bacteria related impairments municipal BMPs could include: implementation or improvement to existing nuisance wildlife programs, septic system monitoring programs, any additional measures that can be added to the required illicit discharge detection and elimination (IDDE) programs, and increased street sweeping above basic permit requirements. Any non-MS4 municipalities can implement these same types of initiatives in effort to reduce bacteria source loading to impaired waterways.

Any facilities that discharge non-MS4 regulated stormwater should update their Pollution Prevention Plan to reflect BMPs that can reduce bacteria loading to the receiving waterway. These BMPs could include nuisance wildlife control programs and any installations that increase surface infiltration to reduce overall stormwater volumes. Facilities that are regulated under the Commercial Activities Stormwater Permit should report any updates to their SMP in their summary documentation submitted to DEEP.

Table 9. Bacteria (e.coli) TMDLs, WLAs, and LAs for Recreational Use

		Instantaneous *E. coli* (#/100mL)						Geometric Mean *E. coli* (#/100mL)	
Class	**Bacteria Source**	**WLA[6]**			**LA[6]**			**WLA[6]**	**LA[6]**
	Recreational Use	1	2	3	1	2	3	**All**	**All**
A	Non-Stormwater NPDES	0	0	0				0	
	CSOs	0	0	0				0	
	SSOs	0	0	0				0	
	Illicit sewer connection	0	0	0				0	
	Leaking sewer lines	0	0	0				0	
	Stormwater (MS4s)	235[7]	410[7]	576[7]				126[7]	
	Stormwater (non-MS4)				235[7]	410[7]	576[7]		126[7]
	Wildlife direct discharge				235[7]	410[7]	576[7]		126[7]
	Human or domestic animal direct discharge[5]				235	410	576		126

(1) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in: Guidelines for Monitoring Bathing Waters and Closure Protocol, adopted jointly by the Department of Environmental Protections and the Department of Public Health. May 1989. Revised April 2003 and updated December 2008.

(2) **Non-Designated Swimming.** Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely.

(3) **All Other Recreational Uses.**

(4) Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of sewage treatment plant effluents is not required consistent with Standard 23. (Class B surface waters located north of Interstate Highway I-95 and downstream of a sewage treatment plant providing seasonal disinfection May 1 through October 1, as authorized by the Commissioner.)

(5) Human direct discharge = swimmers

(6) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations

(7) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP 2011a). Sections 2.2.2 and 6.2.7 of this Core Document deal with BMPs and delineating type of wildlife inputs.

6) Ensure there are sufficient buffers on agricultural lands along the upstream portion of the Tenmile River.

If not already in place, agricultural producers should work with the CT Department of Agriculture and the U.S. Department of Agriculture Natural Resources Conservation Service to develop conservation plans for their farming activities within the watershed. These plans should focus on ensuring that there are sufficient stream buffers, that fencing exists to restrict livestock and horse access to streams and wetlands, and that animal waste handling, disposal, and other appropriate Best Management Practices (BMPs) are in place. Particular attention should be paid to those agricultural operations located within the riparian buffer zone upstream of the impaired segment.

BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL

Table 10: Mixville Pond Bacteria Data

Waterbody ID: CT5202-00-1-L3_01

Characteristics: Freshwater, Class A, Potential Drinking Water Source, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, and Industrial and Agricultural Water Supply

Impairment: Recreation (*E. coli bacteria)*

Water Quality Criteria for E. coli:

Geometric Mean: 126 colonies/100 mL

Single Sample: 235 colonies/100 mL (designated beach)

Percent Reduction to meet TMDL:

Geometric Mean: **20%**

Single Sample: **88%**

Data: 2008-2011 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Mixville Pond with annual geometric means calculated

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
MN	Mixville Pond North	5/27/2008	10	wet	82
MN	Mixville Pond North	6/2/2008	120	dry	
MN	Mixville Pond North	6/9/2008	1400	wet	
MN	Mixville Pond North	6/11/2008	270	dry	
MN	Mixville Pond North	6/16/2008	400	wet	
MN	Mixville Pond North	6/17/2008	**2000* (88%)**	wet	
MN	Mixville Pond North	6/18/2008	120	wet	
MN	Mixville Pond North	6/19/2008	53	dry	
MN	Mixville Pond North	6/23/2008	99	wet	
MN	Mixville Pond North	6/24/2008	42	dry	
MN	Mixville Pond North	6/25/2008	75	dry	
MN	Mixville Pond North	6/26/2008	99	dry	
MN	Mixville Pond North	6/30/2008	220	dry	
MN	Mixville Pond North	7/1/2008	31	wet	
MN	Mixville Pond North	7/3/2008	42	dry	
MN	Mixville Pond North	7/7/2008	53	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Mixville Pond with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
MN	Mixville Pond North	7/10/2008	42	dry	
MN	Mixville Pond North	7/14/2008	1400	wet	
MN	Mixville Pond North	7/16/2008	890	dry	
MN	Mixville Pond North	7/17/2008	190	dry	
MN	Mixville Pond North	7/21/2008	120	dry	
MN	Mixville Pond North	7/22/2008	10	dry	
MN	Mixville Pond North	7/23/2008	210	wet	
MN	Mixville Pond North	7/24/2008	880	wet	
MN	Mixville Pond North	7/28/2008	31	wet	
MN	Mixville Pond North	7/29/2008	75	dry	
MN	Mixville Pond North	7/30/2008	64	dry	
MN	Mixville Pond North	7/31/2008	10	wet	
MN	Mixville Pond North	8/4/2008	42	dry	
MN	Mixville Pond North	8/5/2008	31	dry	82
MN	Mixville Pond North	8/6/2008	20	wet	
MN	Mixville Pond North	8/7/2008	64	wet	
MN	Mixville Pond North	8/11/2008	450	wet	
MN	Mixville Pond North	8/12/2008	42	wet	
MN	Mixville Pond North	8/14/2008	20	wet	
MN	Mixville Pond North	8/18/2008	20	dry	
MN	Mixville Pond North	8/19/2008	110	dry	
MN	Mixville Pond North	8/20/2008	10	dry	
MN	Mixville Pond North	8/21/2008	41	dry	
MN	Mixville Pond North	8/25/2008	450	dry	
MN	Mixville Pond North	8/26/2008	31	dry	
MN	Mixville Pond North	8/27/2008	75	dry	
MN	Mixville Pond North	8/28/2008	10	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Mixville Pond with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
MN	Mixville Pond North	6/8/2009	53	dry	106
MN	Mixville Pond North	6/11/2009	500	dry	
MN	Mixville Pond North	6/15/2009	1200	wet	
MN	Mixville Pond North	6/18/2009	87	wet	
MN	Mixville Pond North	6/22/2009	430	wet	
MN	Mixville Pond North	6/24/2009	99	wet	
MN	Mixville Pond North	6/25/2009	64	dry	
MN	Mixville Pond North	6/29/2009	31	dry	
MN	Mixville Pond North	7/6/2009	42	dry	
MN	Mixville Pond North	7/8/2009	**2000* (88%)**	wet	
MN	Mixville Pond North	7/9/2009	620	wet	
MN	Mixville Pond North	7/13/2009	42	dry	
MN	Mixville Pond North	7/20/2009	31	dry	
MN	Mixville Pond North	7/22/2009	120	wet	
MN	Mixville Pond North	7/23/2009	120	wet	
MN	Mixville Pond North	7/27/2009	10	dry	
MN	Mixville Pond North	8/3/2009	220	dry	
MN	Mixville Pond North	8/10/2009	20	dry	
MN	Mixville Pond North	8/13/2009	590	wet	
MN	Mixville Pond North	8/17/2009	31	dry	
MN	Mixville Pond North	8/24/2009	64	dry	
MN	Mixville Pond North	8/31/2009	31	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Mixville Pond with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
MN	Mixville Pond North	6/1/2010	75	wet	146
MN	Mixville Pond North	6/7/2010	20	dry	
MN	Mixville Pond North	6/15/2010	99	dry	
MN	Mixville Pond North	6/21/2010	42	dry	
MN	Mixville Pond North	6/28/2010	190	dry	
MN	Mixville Pond North	7/6/2010	53	dry	
MN	Mixville Pond North	7/12/2010	313	dry	
MN	Mixville Pond North	7/14/2010	1700	wet	
MN	Mixville Pond North	7/15/2010	1400	dry	
MN	Mixville Pond North	7/22/2010	220	wet	
MN	Mixville Pond North	7/26/2010	10	dry	
MN	Mixville Pond North	8/2/2010	20	dry	
MN	Mixville Pond North	8/9/2010	41	dry	
MN	Mixville Pond North	8/16/2010	950	wet	
MN	Mixville Pond North	8/19/2010	42	dry	
MN	Mixville Pond North	8/23/2010	**2000* (88%)**	wet	
MN	Mixville Pond North	8/24/2010	1700	wet	
MN	Mixville Pond North	8/25/2010	430	wet	
MN	Mixville Pond North	8/26/2010	190	wet	
MN	Mixville Pond North	8/30/2010	20	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Mixville Pond with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
MN	Mixville Pond North	5/31/2011	1000	unknown	134
MN	Mixville Pond North	6/2/2011	140	unknown	
MN	Mixville Pond North	6/7/2011	150	unknown	
MN	Mixville Pond North	6/14/2011	530	unknown	
MN	Mixville Pond North	6/16/2011	81[†]	unknown	
MN	Mixville Pond North	6/23/2011	480	unknown	
MN	Mixville Pond North	6/28/2011	31	unknown	
MN	Mixville Pond North	7/5/2011	42	unknown	
MN	Mixville Pond North	7/12/2011	31	unknown	
MN	Mixville Pond North	7/14/2011	10	unknown	
MN	Mixville Pond North	7/19/2011	53	unknown	
MN	Mixville Pond North	7/26/2011	20	unknown	
MN	Mixville Pond North	8/2/2011	1700	unknown	
MN	Mixville Pond North	8/4/2011	120	unknown	
MN	Mixville Pond North	8/9/2011	270	unknown	
MN	Mixville Pond North	8/11/2011	1000	unknown	
MS	Mixville Pond South	5/27/2008	10	wet	66
MS	Mixville Pond South	6/2/2008	120	dry	
MS	Mixville Pond South	6/9/2008	1200	wet	
MS	Mixville Pond South	6/11/2008	87	dry	
MS	Mixville Pond South	6/16/2008	270	wet	
MS	Mixville Pond South	6/17/2008	1500	wet	
MS	Mixville Pond South	6/18/2008	160	wet	
MS	Mixville Pond South	6/19/2008	99	dry	
MS	Mixville Pond South	6/23/2008	53	wet	
MS	Mixville Pond South	6/24/2008	75	dry	
MS	Mixville Pond South	6/25/2008	31	dry	
MS	Mixville Pond South	6/26/2008	53	dry	
MS	Mixville Pond South	6/30/2008	700	dry	
MS	Mixville Pond South	7/1/2008	64	wet	
MS	Mixville Pond South	7/3/2008	87	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Mixville Pond with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
MS	Mixville Pond South	7/7/2008	240	dry	66
MS	Mixville Pond South	7/10/2008	120	dry	
MS	Mixville Pond South	7/14/2008	830	wet	
MS	Mixville Pond South	7/16/2008	64	dry	
MS	Mixville Pond South	7/17/2008	87	dry	
MS	Mixville Pond South	7/21/2008	150	dry	
MS	Mixville Pond South	7/22/2008	160	dry	
MS	Mixville Pond South	7/23/2008	570	wet	
MS	Mixville Pond South	7/24/2008	810	wet	
MS	Mixville Pond South	7/28/2008	31	wet	
MS	Mixville Pond South	7/29/2008	20	dry	
MS	Mixville Pond South	7/30/2008	10	dry	
MS	Mixville Pond South	7/31/2008	20	wet	
MS	Mixville Pond South	8/4/2008	64	dry	
MS	Mixville Pond South	8/5/2008	42	dry	
MS	Mixville Pond South	8/6/2008	42	wet	
MS	Mixville Pond South	8/7/2008	53	wet	
MS	Mixville Pond South	8/11/2008	240	wet	
MS	Mixville Pond South	8/12/2008	53	wet	
MS	Mixville Pond South	8/14/2008	10	wet	
MS	Mixville Pond South	8/18/2008	10	dry	
MS	Mixville Pond South	8/19/2008	10	dry	
MS	Mixville Pond South	8/20/2008	10	dry	
MS	Mixville Pond South	8/21/2008	10	dry	
MS	Mixville Pond South	8/25/2008	31	dry	
MS	Mixville Pond South	8/26/2008	10	dry	
MS	Mixville Pond South	8/27/2008	20	dry	
MS	Mixville Pond South	8/28/2008	10	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Mixville Pond with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
MS	Mixville Pond South	6/8/2009	87	dry	128
MS	Mixville Pond South	6/11/2009	430	dry	
MS	Mixville Pond South	6/15/2009	660	wet	
MS	Mixville Pond South	6/18/2009	110	wet	
MS	Mixville Pond South	6/22/2009	240	wet	
MS	Mixville Pond South	6/24/2009	87	wet	
MS	Mixville Pond South	6/25/2009	75	dry	
MS	Mixville Pond South	6/29/2009	99	dry	
MS	Mixville Pond South	7/6/2009	10	dry	
MS	Mixville Pond South	7/8/2009	1300	wet	
MS	Mixville Pond South	7/9/2009	660	wet	
MS	Mixville Pond South	7/13/2009	31	dry	
MS	Mixville Pond South	7/20/2009	64	dry	
MS	Mixville Pond South	7/22/2009	140	wet	
MS	Mixville Pond South	7/23/2009	87	wet	
MS	Mixville Pond South	7/27/2009	64	dry	
MS	Mixville Pond South	8/3/2009	140	dry	
MS	Mixville Pond South	8/10/2009	63	dry	
MS	Mixville Pond South	8/13/2009	1300	wet	
MS	Mixville Pond South	8/17/2009	110	dry	
MS	Mixville Pond South	8/24/2009	99	dry	
MS	Mixville Pond South	8/31/2009	31	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Mixville Pond with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
MS	Mixville Pond South	6/1/2010	160	wet	135
MS	Mixville Pond South	6/7/2010	110	dry	
MS	Mixville Pond South	6/15/2010	75	dry	
MS	Mixville Pond South	6/21/2010	160	dry	
MS	Mixville Pond South	6/28/2010	10	dry	
MS	Mixville Pond South	7/6/2010	20	dry	
MS	Mixville Pond South	7/12/2010	64	dry	
MS	Mixville Pond South	7/14/2010	**2000* (88%)**	wet	
MS	Mixville Pond South	7/15/2010	1100	dry	
MS	Mixville Pond South	7/22/2010	210	wet	
MS	Mixville Pond South	7/26/2010	42	dry	
MS	Mixville Pond South	8/2/2010	10	dry	
MS	Mixville Pond South	8/9/2010	20	dry	
MS	Mixville Pond South	8/16/2010	1000	wet	
MS	Mixville Pond South	8/19/2010	87	dry	
MS	Mixville Pond South	8/23/2010	**2000* (88%)**	wet	
MS	Mixville Pond South	8/24/2010	1400	wet	
MS	Mixville Pond South	8/25/2010	410	wet	
MS	Mixville Pond South	8/26/2010	190	wet	
MS	Mixville Pond South	8/30/2010	20	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Mixville Pond with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
MS	Mixville Pond South	5/31/2011	1000	unknown	**158* (20%)**
MS	Mixville Pond South	6/2/2011	64	unknown	
MS	Mixville Pond South	6/7/2011	87	unknown	
MS	Mixville Pond South	6/14/2011	320	unknown	
MS	Mixville Pond South	6/16/2011	112†	unknown	
MS	Mixville Pond South	6/23/2011	530	unknown	
MS	Mixville Pond South	6/28/2011	87	unknown	
MS	Mixville Pond South	7/5/2011	31	unknown	
MS	Mixville Pond South	7/12/2011	160	unknown	
MS	Mixville Pond South	7/14/2011	20	unknown	
MS	Mixville Pond South	7/19/2011	64	unknown	
MS	Mixville Pond South	7/26/2011	20	unknown	
MS	Mixville Pond South	8/2/2011	**2000* (88%)**	unknown	
MS	Mixville Pond South	8/4/2011	140	unknown	
MS	Mixville Pond South	8/9/2011	430	unknown	
MS	Mixville Pond South	8/11/2011	1100	unknown	

Shaded cells indicate an exceedance of water quality criteria

†Average of two duplicate samples

***Indicates single sample and geometric mean values used to calculate the percent reduction**

Wet and dry weather *E. coli* (colonies/100 mL) geometric mean values for all monitoring stations in Mixville Pond

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
MN	Mixville Pond North	2008-2010	34	51	100	222	59
MS	Mixville Pond South	2008-2010	34	51	93	221	52

Shaded cells indicate an exceedance of water quality criteria

Weather condition determined from rain gage at Markham Municipal KMMK station in Meriden, CT

REFERENCES

Costa, Joe (2011). Calculating Geometric Means. Buzzards Bay National Estuary Program. **Online**: http://www.buzzardsbay.org/geomean.htm

CTDEEP (2010). State of Connecticut Integrated Water Quality Report. **Online:** http://www.ct.gov/dep/lib/dep/water/water_quality_management/305b/ctiwqr10final.pdf

CTDEEP (2011). State of Connecticut Water Quality Standards. **Online:** http://www.ct.gov/dep/lib/dep/water/water_quality_standards/wqs_final_adopted_2_25_11.pdf

CWP (2003). Impacts of Impervious Cover on Aquatic Systems. Center for Watershed Protection. **Online**: http://clear.uconn.edu/projects/tmdl/library/papers/Schueler_2003.pdf

Federal Register 67 (March 15, 2002) 11663-11670. Urban Area Criteria for Census 2000.

Jones, S.H. 2008. Microbial Pollution Source Tracking at New Castle Beach. Final Report. New Hampshire Department of Environmental Services, Concord, NH

Mallin, M.A., K.E. Williams, E.C. Escham, R.P. Lowe (2000). Effect of Human Development on Bacteriological Water Quality in Coastal Wetlands. Ecological Applications 10: 1047-1056.

USEPA (2001). Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water. **Online**: http://www.epa.gov/safewater/sourcewater/pubs/fs_swpp_petwaste.pdf.

USEPA (2011a). Managing Nonpoint Source Pollution from Agriculture. **Online:** http://water.epa.gov/polwaste/nps/outreach/point6.cfm

USEPA (2011b). Riparian Zone and Stream Restoration. **Online:** http://epa.gov/ada/eco/riparian.html

USEPA (2011c). Land Use Impacts on Water. **Online:** http://epa.gov/greenkit/toolwq.htm